SYMONS'S

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THE FLOODS OF MARCH 8TH AND 9TH.

(*Concluded from p.* 21.)

WE add a few more general notes upon these floods, and shall then proceed to consider the numerical data with which we have been favoured.

Taunton, Halse House.—On the 8th, over two inches of rain fell. The water was 4 ft. deep down at Halse Water, and the road quite impassable on Friday afternoon. At Mr. Pratt's the water stood 6 in. deep in the bakehouse. Mrs. Pratt said that she had known the house for 60 years, and never saw water in it before. At Bishop's Lydeard the flood was very bad. Mr. Smith and Dr. Mead went about putting food into the bedroom windows to the people, as all the lower rooms were flooded. There were no trains on the Bishop's Lydeard branch on Saturday, the 9th, and none below Bridgewater for 24 hours. The water was so deep that it put out the engine fires.

Bath Literary Institution.—Nine inches of snow fell on the 4th, and much of this was still unmelted on the 6th. The river was about 6 ft. above its ordinary level on Friday, but by the following morning it had risen 8 or 9 ft. higher. The stand containing the instruments was surrrounded with about 3 ft. of water, and the observer had to be carried there on a man's shoulders, who waded in up to his waist. The height of the flood varied in different places; here, in the Institution Gardens, it was about 22 in. below the unprecedented one of 1882; about a half-mile lower down, it was said to be 16 in. below the corresponding point; and in other places the difference was reported as more than 2 ft.

Bristol, Bishopston.—The exceptionally heavy rainfall deserves special record, the more particularly so, as it occurred in what is usually the driest season of the year. The fall was continuous during the 34 hours preceding midnight on March 8th, and during this interval the depth measured reached 2·91 in. Very disastrous floods resulted from this enormous downpour and were much more extensive than those of October, 1882, and do not appear to

have been equalled since April, 1809. There was a heavy snow-storm here throughout Monday, March 4th, which covered the ground to the depth of 6 in.; and the thaw which occurred on the 5th and 6th, served to intensify the effect of the heavy rain which fell on succeeding days.

Ross, The Graig.—I find no record for this district, and have no register of my own, of more than about half as much at this period of the year. Probably March 14th–15th, 1851, would be the largest previous fall approaching in amount. We have had no flood on the river Wye, and no serious one on smaller streams.

Cardiff, Llwynarthen.—Snow fell on 3rd and 4th together to a depth of 9 in. Some roads were submerged for a day or so, but no great damage was done here.

Woolstaston Rectory.—There was a slight fall of snow (·01) on the 1st and 3rd, but none was left when it began again on the 6th. The great fall on the 8th was perfectly even, and measured almost exactly 1 ft. in depth here; but a little higher up on the Longmynd it was much deeper, about $1\frac{1}{2}$ ft.

Coventry, Priory Row.—No snow was on the ground on the evening of March the 6th. Early on the morning of the 7th it was snowing heavily—dry snow. At 9 a.m. it was beginning to thaw, and soon changed to rain. About 11 at night of the 8th, it again turned to snow, which was perhaps an inch deep in the morning of the 9th, but soon melted away. The total fall (2·43) occupied less than 48 hours. The fall was greater on the west side of Coventry, and smaller at Stoke, to the east.

Leicester, Rotherby Hall.—Very large floods all along the valley of the Wreake.

In the following table we give the daily fall on each of the three days, March 6th, 7th and 8th, and the total for the three at all stations from which we have yet heard, and at which the total exceeded 2 inches.

It will simplify matters if, in the first place, we select those at which the fall exceeded 3 inches. They are—

Holne Vicarage.....	4·25	Bishopston..... ..	3·34
Lydeard Ho....	3·67	Llanfrechfa	3·08
Radstock	3·74	Wickwar	3·26
Clifton	3·20	Upfield	3·63

The first of these has little connection with the inquiry. Holne Vicarage is on Dartmoor, with a mean rainfall of 70 or 80 inches a year, therefore a fall of 4·25 inches in three days is not very exceptional, and as the rivers ordinarily have to carry off heavy falls, no serious damage ensued. Damage occurs only where the volume of the rainfall water is unusual, or where human beings (more foolish than beavers) have built upon lands liable to flooding. The high figures from Lydeard and Radstock explain the flooding at Taunton, and the five other returns explain that produced at Bristol by the

overflow of the (Gloucestershire) Frome. But most undoubtedly the terrible loss at Bristol (put at £100,000) is due to neglect of reasonable supervision of the watercourses, and to building where houses should not have been placed until the watercourses had been entirely reorganized. It is a fine of £100,000 for neglect. But we fear that few towns will profit by the lesson; most of them will wait for a lesson at their own expense.

The Leicester floods were apparantly due to accident, the rains, though heavy, not being what can be called exceptional.

Rainfall, March 6th—8th, 1889.

Counties.	Stations.	6th.	7th.	8th.	Total, 6th-8th.
		in.	in.	in.	in.
Devon	Torquay (Babbacome)	1·26	·73	·51	2·50
,,	Ashburton (Holne Vicarage)	1·23	1·81	1·21	4·25
,,	Teignmouth (Woodway)	·77	·76	·55	2·08
,,	Okehampton	·42	·94	1·27	2·63
,,	Hartland Abbey	·57	·65	1·20	2·42
,,	Barnstaple	·50	·84	1·00	2·34
,,	Lynmouth (Glenthorne)	·35	·72	1·70	2·77
Dorset	Beaminster	·82	·72	·49	2·03
,,	Sturminster (Haselbury)	·87	·91	·54	2·32
Somerset	Taunton (Lydeard Ho.)	·40	·76	2·51	3·67
,,	Wells (Westbury)	·40	·52	1·13	2·05
,,	Radstock	1·33	1·03	1·38	3·74
,,	Bath	·63	·74	1·20	2·57
Gloucester	Bristol (Clifton)	·46	·91	1·83	3·20
,,	,, (Bishopston)	·43	·96	1·95	3·34
Glamorgan	Cardiff (Ely)	·40	·97	·93	2·30
Monmouth	Marshfield (Llwynarthan)	·43	·90	1·14	2·47
,,	Llanfrechfa	·48	1·18	1·42	3·08
,,	Monmouth (Hendre)	·19	·84	1·69	2·72
Hereford	Ross	·15	·90	1·53	2·58
Gloucester	Wickwar	·42	1·00	1·84	3·26
,,	Cirencester (Further Barton)	·42	·89	1·04	2·35
,,	Stroud (Upfield)	·43	1·10	2·10	3·63
Worcester	Evesham (Lansdowne)	·15	·75	1·63	2·53
,,	Worcester (Diglis Lock)	·15	·62	1·24	2·01
Warwick	Nuneaton (Bedworth)	·21	·85	1·29	2·35
,,	Coventry (Coundon)	·14	1·13	1·47	2·74
,,	,, (Priory Row)	·18	·85	1·40	2·43
Leicester	Barkby Vicarage	·09	·85	1·94	2·88
,,	Ratcliffe College	·00	·83	1·91	2·74
,,	Rotherby Hall	·02	·76	2·04	2·82
,,	Loughborough	·06	·75	2·06	2·87
Derby	Belper	·12	·39	1·53	2·04
Nottingham	Mansfield	·10	·40	1·75	2·25

REVIEWS.

The Great Storm off the Atlantic Coast of the United States, March 11th to 14th, 1888. By EVERETT HAYDEN. Hydrographic Office, U.S.A. Nautical Monograph No. 5. Government Printing Office, Washington, 1888. 4to, 66 pages, 6 plates.

THIS monograph would have greatly delighted Admiral FitzRoy, for the charts are tinted in red (for warmth) and blue (for cold), just as he loved to have them, and all through, the author shows more sympathy with the Admiral's habits and thoughts than has been shown in any English work that we have seen.

The storm is the one which produced the "Blizzard in New York, March 12th," which was described in the *Meteorological Magazine* for April last, p. 34. The work is illustrated by a synoptic chart of the Eastern portion of the United States and of Canada, and of the Western Atlantic for 7 a.m. of each day from March 11th to 14th, both inclusive, also by a track chart and a barometer diagram. The text gives a history of the principal events of each day in a series of chapters, which may almost be regarded as diaries. These are followed by others on the use of oil in stilling waves, on the wreckage along the coast, and by various appendices giving the original statements as sent by the observers.

We notice in the preface some remarks in apology for delay in publication. No such apology is needed; there are few establishments in the world which would have issued a work so promptly. We could quote many offices which have not issued their reports for 1887, some which have not yet issued 1886, and at least one which has not yet finished 1885.

Jahrbuch der Meteorologischen Beobachtungen der Wetterwarte der Magdeburgischen Zeitung. By A. W. GRUETZMACHER. Jahrgang V., 1886. Faber'sche Buchdruckerei, Magdeburg 1888. 4to, 40 pages. 14 plates.

THE high level of excellence at which this publication was fixed by Dr. Assmann is being maintained by his successor, and as we have on a previous occasion fully described the publication, we need only chronicle the above fact, and note one or two changes.

The excellent plan of reproducing the barograph traces for such periods only as show sudden and marked changes is continued.

All the daily records of the Jordan sunlight recorder are reproduced on their natural size, and they are most interesting. It seems to us also to be a better plan to give the total duration of sunshine in minutes, instead of in hours and minutes as has hitherto been the practice. A curve representing the total sunlight of each month might with advantage be added on page 32, but on the whole the work reflects much credit upon the editor, and on the proprietors of the *Magdeburgischen Zeitung*, who we believe bear the entire cost.

Studi sulla comparazione degli Anemometri. PROF. DOMENICO RAGONA. Estratto dagli Annali della Meteorologia Italiana Pt. 1, 1886. Metastasio, Roma 1888, fol. 16 pages, 1 plate.

NOTHING is so hard to kill as error. About forty years since, our dear old friend Dr. Robinson stated that anemometer cups moved with one third of the velocity of the wind. He, Dohrandt and others have since shown that the rule was wrong, and that the factor is never 3 to 1, but is variable, but probably not far from 2·3 to 1; papers on the subject have appeared in many of the leading publications of Europe, and yet here on the very first page of his memoir Prof. Ragona says :—

"I centri degli emisferi percorrono una circonferenza uguale a metri 3,333 e in conseguenza, giusta la ben nota *convenzione fondamentale*, una rotazione del mulinello corrisponde a 10 metri della velocità del vento."

It is quite possible that in the words which we have put in italics, he is firing a sly shot at the many important offices, the English one among them, which go on using the factor of 3 to 1 when they know that it is incorrect.

As regards the present paper (which is a comparison of two anemometers each driven by Robinson's cups) the factor employed is of no importance, and therefore, we can pass on to state briefly the object of the memoir. It describes the pattern of anemometer made by Brassart and adopted by the Italian Meteorological Office,* and explains comparisons made between it and a small one by Salleron; the results are we think very similar to those which have been obtained in this country, and not less unsatisfactory.

Vero andamento diurno della Temperatura. PROF. D. RAGONA. Società Tipografica, Modena, 1889, 4to, 27 pages.

THIS is a discussion of two years' records (June 1869 to May 1871), from the self-recording metallic thermometer at Modena, made by Salleron, of Paris. The period is of course too short to give absolute values, but the tables show clearly how much later in the day the maximum temperature occurs in Modena than in this country.

Climatology of New Jersey. By J. C. SMOCK. [From the final report of the State Geologist, Vol. I.] Murphy, Trenton, New Jersey, U.S.A., 1888, 8vo. 96 pages.

SOMETIMES those who come fresh to a subject treat it better than those whose whole lives have been devoted to it. Mr. Smock, is, we believe, a geologist, and we have no recollection of meeting with his

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* We venture to suggest that it would be improved if the velocity of rotation of the communicating rod were lessened, by the wheel *p* being decreased in size, and *q* increased.

name in connection with meteorology, and yet here is a memoir which we can describe as aggravatingly good—aggravatingly, because we cannot afford space for the many quotations which we should like to make.

New Jersey is slightly larger than Wales, and in about the same latitude as Madrid and Constantinople, yet its mean temperature is scarcely equal to that of London, while its vicissitudes are extreme. An interesting plate gives the monthly mean temperature for four districts, and shows that even on the sea coast the monthly means for July and January differ by 41°, while at Greenwich the corresponding difference is 25° or not much more than half. This variability comes out even more markedly in the table of extremes, where among the maxima there are several between 100° and 104°, and the mildest minimum is —7° or 39° below freezing,

The author has been persevering and fortunate in hunting up much collateral information, which not only checks the meteorological records, but makes the paper most interesting. For instance, on p. 345, he gives the earliest and latest frost of each year, from 1865 to 1887, the records being based not upon thermometers, but upon damage to tender plants. The values are—

Last in Spring.	Earliest in Autumn.	Duration of Season.
Earliest, April 9.	October 5.	Longest, 203 days.
Average, April 25.	October 22.	Average, 180 ,,
Latest, May 15.	November 8.	Shortest, 143 ,,

On pages 413 to 416, we have a list of the dates of the opening and closing of the Hudson river at Albany, for every year from 1789 to 1888, and shorter lists are given for the Delaware river and for two canals.

There is but one table which we miss, viz., one of the yearly totals of rainfall at each station, so that we might have had some information as to its fluctuation from year to year. Mr. Smock gives us a pretty looking table of mean monthly rainfall at 74 stations, but, as he himself partly hints, it is very unsatisfactory, some of the means (?) being based upon only *one* year—while perhaps the very next line of figures embodies the valuable result of twenty or thirty years' work. If the short period observations had been omitted, the table would have been half the size, and incomparably better.

Among the many interesting features of the book, we had nearly forgotten to mention a list of chronological notes on the weather from 1607 to 1887.

ANCHOR ICE.

To the Editor of the Meteorological Magazine.

SIR,—Seeing in your last number the question about "Anchor" or "Ground Ice" mentioned, I thought you might like to see a short paper I wrote on the subject. Anchor ice often occurs in great quantities in the river Ouse, and in the year 1887 was very marked, more particularly as to the great quantity of débris brought from the river bottom, and carried often a long distance, a heavy striking hammer, lost when a bridge was making over the river was brought up, as well as heavy stones, bricks, coals, chains, knives, pottery, the zebra mussel (*dreissena polymorpha*) in great quantities, bones, &c. As our river is thick when in flood, as was the case in point, I do not think that radiation has much, if anything, to do with it; still I should not like to say it has not, when others, wiser than myself, think it is one of the factors when "Anchor ice" is formed.

Yours truly,

JOHN BROWN.

Earith, near St. Ives, Hunts., 19*th March*, 1889.

[We are glad of the opportunity of laying Mr. Brown's excellent paper before our readers. It seems to us that his stricture on the radiation theory has considerable weight].—ED. *M.M.*

ANCHOR ICE.

IT will help in the explanation of this phenomenon if we consider what crystallization is, and how surface ice is formed. Crystallization is the spontaneous collecting or grouping together of certain regular forms known as crystals when fluids assume the solid state. This can take place only under certain favourable conditions, the principal of which are temperature, chemical action, electricity, evaporation, and the presence of suitable points for the crystals to form upon. The conditions under which water will form into ice crystals are these:—The water must be cooled down to 32° Fahr., freezing point; there must also exist some starting points for the crystals to form upon and aggregate round each other. Surface ice is formed upon rivers, ponds, and lakes when the water on the surface has been cooled down to 32° Fahr. This has been promoted by the body of the water having been cooled below 39° Fahr. by the law of circulation which always asserts itself when there exists a difference of temperature in the same fluid. The water on the surface having been cooled by contact with the frosty air, sinks down, its place being taken by a stratum of water of higher temperature. Which in its turn is in like manner cooled and sinks; the process is thus repeated, until a uniform temperature is produced 39° Fahr. At this temperature water having acquired its greatest density, the action of the law of circulation is reversed, the coldest water being now the lightest is found at the surface.

The ice crystals then begin to form, using the edges of the river

pond, or lake, as their necessary starting points; from which, veins of crystals are seen to shoot out resembling the back of a leaf; upon these veins more crystals form, filling in from vein to vein, the surface is thus rapidly covered. The crystallization is now continued on the underside adding thickness to the ice as long as the same conditions are maintained. The veins described are well seen in what is usually known as cat's ice. Surface ice, when formed upon running water, is formed in the same way as upon ponds or other still waters, but as the tendency of running water is to retard the formation of ice crystals, and also to disperse them when formed, it requires more frost before the ice crystals can form with sufficient rapidity to overcome these unfavourable conditions and spread over the surface. As a rule when rivers in this country are above their usual height the current is too strong for them to get frozen over. It is only when the water is at, or below, its normal height that surface ice is formed upon them.

The formation of anchor ice can take place only in running water, when the thermometer is below the freezing point; and the phenomenon may be thus explained. Independently of the circulation already described arising from difference of temperature, but acting in conjunction with it, is the mechanical circulation of running water; this dual, yet combined, action leads to the entire mass of water being cooled down to 32 deg. Fahr. This point of temperature being reached, the ice crystals, obedient to law, begin to form. But the current being too strong for them to do this upon the surface as upon still water, the asperities at the bottom (where the current is less rapid), supply the needed starting points round which the ice crystals rapidly group themselves. These asperities consist of stones, weeds, broken vessels, bricks, coal, shells, sticks &c. The cooling down of the water of a river to 32 deg. Fahr. by circulation is not the only effect produced; the asperities at the bottom are in like manner cooled down by the refrigerated water running over them, abstracting such heat as may be in excess of 32 deg. Fahr., reducing them to this temperature, and thus conducing to the formation of the ice crystals upon them. After the ice crystals have thus formed in masses, and when these masses, augmented by more ice crystals, have gained sufficient buoyancy to lift the substances to which they are attached, they rise to the surface, bringing with them the weeds, stones, coal, bricks, &c., round which they have grouped themselves. These masses of anchor ice are not firm and solid like surface ice, being a collection of ice crystals somewhat loosely bonded together. It is only after having formed into a larger mass on the surface, or collected into a sheet of drift ice, that it assumes the hard and compact nature of ordinary ice, having always a very rough surface. The lifting of heavy substances by anchor ice is not so difficult as it first appears. Ice having a less specific gravity than water does, as we know, float, and it has a lifting power equal to the difference between the weight of a

given quantity of ice and of the water displaced by it. From the fact that the stones, shells, and other substances are in water, all there is to be raised by the ice when lifting these substances is the difference of the weight between the substance lifted and an equal bulk of water, and not the gross weight.

The temperature of running water when anchor ice is forming has been made a matter of experiment here. The result was found to be 32° Fahr. from the bottom of the river to the top. This year a large quantity of anchor ice has formed in the river Ouse, and was seen floating down for several days together, until in some places the river became quite blocked with it. As it melts where left upon the banks, it leaves quantities of *débris* brought from the bottom of the river, sometimes bringing to light interesting relics of bygone times.*

J. B.

Earith, January, 1887.

ROOKS AS WEATHER INDICATORS.

To the Editor of the Meteorological Magazine.

SIR,—If it please you to insert this letter in a future issue of your *Meteorological Magazine*, it gives you another sure indicator of weather.

In bright, fine weather we may often notice the rooks whirling in circles at a great height in the air, from which height (upwards of ¼ mile sometimes), they will pitch down at a great pace one after another, as if they would fall on the ground, and kill themselves. But no: rooks are wise birds, and never do anything without *cause;* it is merely a little game of their own (called "break-neck" in these parts), in which they indulge whilst the weather is fine; for no doubt they know full well that *in three or four days* there will be stormy weather, which surely enough comes to pass in the district, and generally in the place. On March 3rd, I noticed the rooks at this break-neck game, and pointed it out to a neighbour with whom I was, remarking, "See if we do not have stormy weather in a few days." On the following Thursday and Friday, 7th and 8th, we had 2·79 in. of rainfall in 41 hours as the rook-prophetic fulfilment.—Yours faithfully,

E. N. POCHIN.

Barkby Vicarage, Leicester, March 12th, 1889.

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* "Sinkers" or stones with holes bored in them, formerly used by fishermen for weighting their nets; also Roman pottery.

GERMAN METEOROLOGICAL SOCIETY.

This society met at Berlin on March 12th, Prof. von Bezold, president, in the chair.—Dr. Wagner spoke on the connection between cosmic and meteorological phenomena. After a short review of the earlier attempts to connect meteorological phenomena with the rotation of the sun or with the phases of the moon, he passed on to a consideration of Prof. von Bezold's recently published work, in which it is shown that the storms in Bavaria and Würtemberg have a distinctly recurrent periodicity of 26 days, corresponding to the period (25·84 days) of the sun's rotation. In opposition to this, Köppen had found from his own calculations, based on more extensive data, that the storms are recurrent with a periodicity of 29 and not 26 days, thus corresponding to the synodical period of the moon. The speaker himself had investigated the periodicity of storms, not only in Bavaria and Würtemberg, but also in Baden, keeping the observations of lightning separate from those of mere rain-storms; this seemed to be necessary, not only inasmuch as von Bezold did not take any account of lightning, but also because the occurrence of lightning at the time of new moon, or during the last quarter of the moon, might give rise to apparent maxima resulting from purely optical causes. He found that the storms possess a periodicity of 29 days, which include three maxima, the chief of these being in the last half-quarter, the next at new moon, and the least at full moon. No physical explanation, or even any idea of any connection between the storms and the phases of the moon, can at present be given.—Dr. Assmann gave an account of a phenomenon which had been observed on the trees in the Thiergarten as a result of the recent heavy snow-fall. The masses of snow which were piled up high on the branches of the trees had slipped down round their sides and hung down like curtains; they possessed a not inconsiderable consistency and glacier-like structure. The superficial thawing which occurred daily about midday had contributed largely to bring about the modification which the snow had undergone.

ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting of this Society was held on Wednesday evening, March 20th, at the Institution of Civil Engineers, Dr. W. Marcet, F.R.S., President, in the Chair.

Messrs. A. J. Hands, F.S.A., J. Jackson, S. A. Jones, J. E. Middlehurst, and L. Sutton, F.R.G.S., were elected Fellows of the Society.

Dr. Marcet delivered an address on "The Sun—its Heat and Light," in which he explained the composite nature of the solar beam, and the modifications which it undergoes in passing through

our atmosphere. He thus laid the foundation for subsequent remarks on the fine collection of Actinometers and Sunshine Recorders which the Society had collected for its exhibition.

The meeting was then adjourned in order to afford the Fellows and their friends an opportunity of inspecting the exhibition which was devoted principally to Actinometers, Solar Radiation Apparatus, and Sunshine Recorders, but included several new instruments, and many photographs of meteorological interest.

Among the instruments shown for ascertaining the absolute heating effect of the sun's rays, were Herschel's, Hodgkinson's, and Stewart's Actinometers, Pouillet's and Angstrom's Pyrheliometers, and Secchi's Solar Intensity Apparatus. There were also Luvini's Dietheroscope for observing optically the changes of atmospheric refraction, Bellani's Lucimeter as used in Italy, and Crookes' Radiometer, in which the arms rotate with more or less velocity under the action of radiation.

An interesting collection of Sunshine Recorders also was exhibited, among which were the Campbell-Stokes and Whipple-Casella burning Recorders, and the Jordan and McLeod Photographic Recorders.

Several new Barometers, Anemometers, Nephoscopes, &c., also were shown, as well as the stephanome, which is used at the Ben Nevis Observatory for measuring the angular size of halos, fog-bows and glories.

Mr. Clayden showed an ingenious working model of the Atlantic Ocean, illustrating the formation of ocean currents in general, and of the Gulf Stream in particular. Models of very large hailstones, 7 inches in circumference, which fell near Montereau, France, on August 15th last, were also exhibited.

The exhibition included a very interesting collection of photographs of flashes of lightning, of clouds taken in various parts of the world, and of views taken on the summit of Ben Nevis.

CLIMATOLOGICAL TABLE FOR THE BRITISH EMPIRE, SEPTEMBER, 1888.

STATIONS. (*Those in italics are South of the Equator.*)	Absolute. Maximum. Temp.	Date.	Minimum. Temp.	Date.	Average. Max.	Min.	Dew Point.	Humidity.	Absolute. Max. in Sun.	Min. on Grass.	TotalRain. Depth.	Days.	Aver. Cloud.
	°		°		°	°	°	0–100	°	°	inches		0–10
England, London	72·7	15	42·4	1	65·2	50·0	50·1	80	116·3	36·3	1·43	14	6·0
Malta	91·1	9	64·0	30	84·0	69·7	67·9	76	143·3	57·2	·63	2	2·6
Cape of Good Hope.	...	...	...	...	...	...	...	...	...	...	...	...	...
Mauritius	79·5	12	60·4	6,13,27	75·8	64·1	59·4	72	128·6	52·7	1·03	16	5·9
Calcutta	91·3	15	75·2	18	87·7	77·8	77·0	80	159·0	72·9	9·97	16	6·5
Bombay	86·8	18	74·8	12	85·8	77·2	75·0	80	144·3	70·2	4·92	14	5·6
Ceylon, Colombo	87·2	15	73·8	21	86·0	76·4	71·2	73	147·0	70·0	3·26	16	6·0
Melbourne	80·1	14	34·4	5	62·5	45·8	46·0	75	128·8	28·1	1·28	8	6·1
Adelaide	84·7	18	38·7	5	69·3	50·1	46·8	62	139·8	31·9	1·19	13	5·7
Wellington	64·0	29	37·0	7,14	57·5	44·6	43·7	72	121·0	28·0	1·81	10	3·6
Auckland	67·0	30	40·0	13	59·8	47·5	45·8	75	135·0	36·0	·91	10	6·5
Jamaica, Kingston	93·3	16	70·6	5	90·1	73·2	74·3	78	...	...	6·67	...	...
Barbados	...	...	...	...	..	...	...	...	...	...	...	...	...
Toronto	77·6	9	32·1	30	65·7	47·6	49·5	78	...	25·0	3·29	14	4·4
New Brunswick, Fredericton	75·8	25	30·0	30	63·3	44·7	49·0	80	...	...	4·44	15	6·4
Manitoba, Winnipeg	82·8	2	23·3	12	66·7	41·2	45·7	77	...	...	1·53	14	4·7
British Columbia, Victoria	79·0	1	38·0	10	69·0	45·2	...	...	...	...	1·01	7	...

REMARKS, SEPTEMBER, 1888.

MALTA.—Mean temp. 76°·0; mean hourly velocity of wind 6·7 miles. Sea temp. nearly stationary at 78°·9. TS on 18th. L on 19th, 27th, and 28th. Wind velocity much below average. J. SCOLES.

Mauritius.—Mean temp. of air 0°·4, of dew point 0°·1, and R ·54 in. below their respective averages. Mean hourly velocity of wind 10·3 miles, or 1·7 below average; extremes 24·6 on 1st and 2·2 on 6th and 13th. Prevailing direction, S.E. by E. to E.S.E. C. MELDRUM, F.R.S.

Melbourne.—Mean temp. of air 1°·0, of dew point 2°·4 and humidity 4 above the average; mean amount of cloud same as 30 years' average; R 1·03 in. below average. Prevailing winds N. and S.; strong on 8 days. Heavy dew on 5 days. Hoar frost on 9th. Fogs on 2 days; L on 3 days. Lunar rainbows on 21st and 22nd. R. L. J. ELLERY, F.R.S.

Adelaide.—Remarkably Warm. Mean temp. nearly 3° above the average of 31 years. Unusually long spell of warm weather in the middle of the month. R two-thirds of the average. C. TODD.

Wellington.—Fine, with a small rainfall. Prevailing wind N.W. and moderate, except fresh on 3 days, hail squalls on 11th and 12th. Earthquakes on 1st and 5th. R B. GORE.

Auckland.—An unusually fine and dry month, the R being less than one-third of the average and the smallest ever recorded in September. Mean temp. slightly below average, barometric pressure considerably above. T. F. CHEESEMAN.

VICTORIA.—A lovely month, with very little fog.

SUPPLEMENTARY TABLE OF RAINFALL, MARCH, 1889.

[For the Counties, Latitudes, and Longitudes of most of these Stations, see *Met. Mag.*, Vol. XIV., pp. 10 & 11.]

Div.	STATION.	Total Rain.	Div.	STATION.	Total Rain.
		in.			in.
II.	Dorking, Abinger Hall.	2·89	XI.	Castle Malgwyn	2·72
,,	Margate, Birchington...	1·24	,,	Rhayader, Nantgwillt..	4·82
,,	Littlehampton	1·46	,,	Carno, Tybrith	3·96
,,	Hailsham	1·70	,,	Corwen, Rhug	2·29
,,	Ryde, Thornbrough	2·35	,,	Port Madoc	4·04
,,	Alton, Ashdell.....	3·13	,,	I. of Man, Douglas	2·36
III.	Oxford, Magdalen Col...	1·69	XII.	Stoneykirk, Ardwell Ho.	2·94
,,	Banbury, Bloxham	2·69	,,	New Galloway, Glenlee	3·25
,,	Northampton	2·09	,,	Melrose, Abbey Gate...	2·50
,,	Cambridge, Beech Ho...	1·12	XIII.	N. Esk Res. [Penicuick]	2·45
,,	Wisbech, Bank House..	1·81	XIV.	Ballantrae, Glendrishaig	2·54
IV.	Southend	·93	,,	Glasgow, Queen's Park.	1·26
,,	Harlow, Sheering	1·41	XV.	Islay, Gruinart School..	2·73
,,	Rendlesham Hall	·62	XVI.	Dollar.....	·83
,,	Diss	1·33	,,	St. Andrews, Pilmour Cot	1·47
,,	Swaffham	1·10	,,	Balquhidder, Stronvar..	2·77
V.	Salisbury, Alderbury...	2·11	,,	Dunkeld, Inver Braan..	1·59
,,	Warminster	2·82	,,	Dalnaspidal H.R.S. ...	3·22
,,	Bishop's Cannings	2·42	XVII.	Keith H.R.S.	1·96
,,	Ashburton, Holne Vic....	7·37	,,	Forres H.R.S.	1·10
,,	Hatherleigh, Winsford.	3·01	XVIII.	Strome Ferry H.R.S....	6·22
,,	Lynmouth, Glenthorne.	4·31	,,	Fearn, Lower Pitkerrie.	1·19
,,	Probus, Lamellyn	4·45	,,	Loch Shiel, Glenaladale	9·77
,,	Launceston, S. Petherwin	3·88	,,	N. Uist. Loch Maddy ...	3·33
,,	Wincanton, Stowell Rec.	2·48	,,	Invergarry	4·14
,,	Taunton, Lydeard Ho...	4·75	,,	Loch Ness, Drumnadrochit	2·44
,,	Wells, Westbury.....	3·59	XIX.	Lairg H.R.S.	3·22
VI.	Bristol, Clifton	4·38	,,	Forsinard H.R.S.	..
,,	Ross	3·28	,,	Watten H.R.S.	1·68
,,	Wem, Clive Vicarage ...	2·51	XX.	Dunmanway, Coolkelure	3·77
,,	Cheadle, The Heath Ho.	3·31	,,	Fermoy, Gas Works ...	1·32
,,	Worcester, Diglis Lock	2·61	,,	Tipperary, Henry Street	1·04
,,	Coventry, Coundon	4·05	,,	Limerick, Kilcornan ...	1·41
VII.	Ketton Hall [Stamford]	2·36	,,	Miltown Malbay.....	2·00
,,	Grantham, Stainby	2·48	XXI.	Gorey, Courtown House	1·08
,,	Horncastle, Bucknall ...	2·39	,,	Navan, Balrath	1·90
,,	Mansfield, St. John's St.	4·08	,,	Mullingar, Belvedere ...	1·92
VIII.	Neston, Hinderton	2·36	,,	Athlone, Twyford	2·11
,,	Knutsford, Heathside ...	3·30	,,	Longford, Currygrane...	1·66
,,	Lancaster, South Road.	3·00	XXII.	Galway, Queen's Coll...	1·51
,,	Broughton-in-Furness ..	4·38	,,	Clifden, Kylemore	5·58
IX.	Wakefield Prison	3·16	,,	Crossmolina, Enniscoe..	2·50
,,	Ripon, Mickley	2·93	,,	Collooney, Markree Obs.	2·39
,,	Scarborough, West Bank	2·37	,,	Ballinamore, Lawderdale	1·80
,,	East Layton [Darlington]	2·08	XXIII.	Warrenpoint	3·09
,,	Middleton, Mickleton..	1·73	,,	Seaforde	4·07
X.	Haltwhistle, Unthank..	2·62	,,	Belfast, New Barnsley..	3·48
,,	Shap, Copy Hill	2·67	,,	Bushmills, Dundarave...	2·28
XI.	Llanfrechfa Grange	4·53	,,	Stewartstown	1·38
,,	Llandovery	3·66	,,	Buncrana	2·71

MARCH, 1889.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average. 1870–9	Greatest Fall in 24 hours. Dpth	Greatest Fall in 24 hours. Date.	Days on which ·01 or more fell.	TEMPERATURE Max. Deg.	Max. Date	Min. Deg	Min. Date.	No. of Nights below 32° In shade.	No. of Nights below 32° On grass.
			inches	inches.	in.								
I.	ENGLAND.	London (Camden Square) ...	1·36	— ·25	·37	7	13	59·6	24	19·2	4	12	21
II.		Maidstone (Hunton Court)...	1·85	+ ·27	·55	7	15	...	...	...	...	...	...
,,		Strathfield Turgiss	1·91	+ ·51	·33	7	17	62·3	29	20·4	4	15	23
III.		Hitchin	1·40	— ·08	·32	20	13	59·0	24*b*	16·0	3	14	...
,,		Winslow (Addington)	1·95	+ ·19	·38	19	11	63·0	24	18·6	4	15	20
IV.		Bury St. Edmunds (Culford)	1·71	+ ·15	·62	8	6	50·0	13*c*	10·0	3, 4	17	...
,,		Norwich (Cossey)	·83	— ·86	·40	7	7	63·0	25	12·0	5	4	13
V.		Weymouth(LangtonHerring)	1·57	...	·60	6	14	59·0	29	25·0	2	12	...
,,		Barnstaple.....	3·43	+ ·94	1·00	8	13	54·0	14	26·0	2	...	...
,,		Bodmin	5·50	+ 2·34	1·92	4	18	53·0	29	25·0	2	9	14
VI.		Stroud (Upfield)	4·80	+ 2·99	2·10	8	16	60·0	24*b*	25·0	4, 15	16	...
,,		ChurchStretton(Woolstaston)	2·37	+ ·21	1·01	8	16	59·0	29	22·5	4	16	19
,,		Tenbury (Orleton)	2·80	+ ·93	1·14	8	18	63·5	29	21·7	4	13	18
VII.		Leicester (Barkby)	4·08	+ 2·81	1·94	8	14	63·0	29	15·0	3	17	22
,,		Boston	2·03	+ ·74	·68	7	12	64·0	24	24·0	4	12	...
,,		Hesley Hall [Tickhill].....	3·47	...	1·40	8	11	62·0	24	19·0	4	12	...
VIII.		Manchester (Ardwick).....	2·64	+ ·19	·90	8	14	64·0	24	34·0	4	0	...
IX.		Wetherby (Ribston Hall) ...	1·35	— ·78	·54	21	7	...	...	...	...	...	...
,,		Skipton (Arncliffe)	5·70	+ ·94	1·27	24	17	...	...	...	...	...	...
,,		Hull (People's Park)	2·33	+ ·52	1·35	8	16	...	...	...	...	...	...
X.		North Shields	2·57	+ 1·12	·90	19	15	61·5	24	11·5	4	15	19
,,		Borrowdale (Seathwaite).....	8·88	— 1·01	2·70	24	19	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely).....	3·85	+ 1·16	·97	7	15	...	...	...	...	...	...
,,		Haverfordwest	2·29	— ·90	·26	23	18	54·8	24	24·0	2	9	20
,,		Plinlimmon (Cwmsymlog) ...	5·23	...	1·07	23	15	...	...	...	...	...	...
,,		Llandudno.....	1·72	— ·16	·76	19	18	51·5	25	25·5	4, 5	5	...
XII.	SCOTLAND.	Cargen [Dumfries]	3·12	+ ·34	1·78	6	11	55·8	16	19·0	4	15	...
,,		Jedburgh (Sunnyside).....	2·83	+ 1·26	·93	19	9	55·0	29	19·0	4	15	...
XIV.		Old Cumnock	2·56	— ·37	·50	24	19	53·0	29	15·0	2	14	...
XV.		Lochgilphead (Kilmory)	2·78	— 1·83	·48	23	20	...	...	...	...	...	...
,,		Oban (Craigvarren)	3·97	...	·92	23	23	53·0	24	25·6	3	8	...
,,		Mull (Quinish).....	4·04	...	1·10	7	14	...	...	...	...	...	...
XVI.		Loch Leven Sluices	1·40	— ·72	·30	7, 18	9	...	...	...	...	...	...
,,		Dundee (Eastern Necropolis)	1·70	— ·06	·65	2	11	60·6	24	19·4	4	13	...
XVII.		Braemar	·99	— 1·20	·20	18	17	60·0	28	8·0	2	16	24
,,		Aberdeen (Cranford)	2·35	...	·57	19	20	64·0	24	8·0	4	11	...
VIII		Lochbroom	4·40	...	·61	23	26	...	...	...	...	...	...
,,		Culloden	1·12	— ·63	...	...	...	57·0	24*d*	20·0	4	8	21
XIX.		Dunrobin	1·68	...	·36	19	11	59·8	29	25·0	2	13	...
,,		S. Ronaldsay (Roeberry).....	2·41	+ ·26	·39	12	23	...	...	...	...	...	...
XX.	IRELAND.	Cork (Blackrock)	1·64	— 1·12	·44	3	10	61·0	14	27·0	4, 9	10	...
,,		Dromore Castle	3·78	...	·60	23*a*	14	64·0	15	29·0	3	...	...
,,		Waterford (Brook Lodge) ...	1·33	...	·42	18	18	59·0	13	25·0	10	11	...
,,		O'Briensbridge (Ross)	2·04	...	·68	6	14	60·0	28*b*	26·0	11	7	...
XXI.		Carlow (Browne's Hill)	1·23	— ·88	·47	18	15	...	...	...	...	...	...
,,		Dublin (FitzWilliam Square)	1·08	— ·65	·38	19	17	58·3	28	31·0	3	5	14
XXII.		Ballinasloe	1·97	— ·41	·53	6	16	54·0	29	22·0	2	15	...
XXIII		Waringstown	2·38	+ ·32	·55	27	20	58·0	29	25·0	1	11	14
,,		Londonderry (Creggan Res.).	2·87	...	·84	27	23	...	...	...	...	...	...
,,		Omagh (Edenfel)	2·31	+ ·22	·58	19	22	53·0	14*d*	27·0	1	10	14

a And 24. *b* And 29. *c* And 24, 25. *d* And 28, 29.
+ Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON MARCH, 1889.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

STRATHFIELD TURGISS.—The weather of the month was generally cloudy and unsettled, with temp. below the average. A good deal of rain fell locally, with H on 31st. Towards the end of the month there was a considerable depression of the bar., with strong winds from N.W. Snowdrops in flower on 1st; blackbird's nest and eggs found on the 17th; thrush's nest and eggs on the 22nd.

HITCHIN.—One of the driest quarters ever experienced; after two very dry years.

WINSLOW, ADDINGTON.—Frosts frequent during the month, very sharp on the 3rd and 4th: from 19th to 21st stormy, with pressure at 9 a.m. on the 20th 28·919 in. (corr.) Altogether a favourable time for the land, which was in capital order for receiving seeds.

WEYMOUTH, LANGTON HERRING.—R ·29 in. below the average; mean temp. (41°·3) 0°·3 below the average. There was a heavy storm on 8th, preceded by a foggy day. The wind was high on 26th, and on 29th the weather was sultry and thundery.

BODMIN.—A very genial month. Mean temp. 41°·2.

WOOLSTASTON.—The month opened with 12 days of very severe weather, S falling on the 1st, 3rd, 7th, and 8th; on the latter day there was an even fall 1 ft. deep, which broke down the trees in all directions. The latter half of the month was warmer, though S fell on 20th and there were many severe frosts at night. Mean temp. 38°·9.

ORLETON.—The first 12 days were cold and frosty, with a temp. 5° below the average, frost every night and frequent light falls of S. S mixed with R set in before 6 a.m. on the 7th and continued till 10 p.m. on the 8th, and during this time the ground was covered with wet snow often 2 inches deep, but on the hills it was more than 12 inches deep. The S melted gradually on the hills and the river was not flooded, though 1·79 in. was measured in the rain gauge for the two days. The remainder of the month was variable, with several severe frosts at night and a few warm days. Pressure variable, but generally high. Prevailing wind N., frequently very rough. Mean temp. 0°·3 below the average of 28 years.

BARKBY.—Great floods on the 8th. Mean temp. 40°·3.

ARDWICK, MANCHESTER.—This month was fairly mild, with a few bright spring days. Very dark and stormy on 20th. S fell on 8th, but did not remain on the grounnd more than a few hours.

HULL.—The weather during the first eight days was cold, with frequent showers of H, sleet, S and R, sometimes with mist or fog; from that date to the 18th fine weather prevailed generally, with light clouds, but from the 18th to the end it was showery, and sometimes stormy.

WALES.

HAVERFORDWEST.—The month commenced with severe weather, S and violent winds from N.N.E. to E.; it continued very cold up to the 11th, with S on the ground for some days, and the Precelly range white. Changeable, wet and cold weather prevailed throughout the remainder of the month, though in the last week it improved a little. Mean temp. about the average.

SCOTLAND.

CARGEN.—The first 11 days were unusually cold, and considerably more than half the total R of the month fell on the 6th.

JEDBURGH.—The weather was generally dry, but cold and ungenial, with low temp. at night, and keen winds, which kept the soil dry for seed sowing. Spring flowers in bloom. S on 19th, 20th, and 21st.

LOCHBROOM.—An unusually open month, with very little S and no frost, but a good deal of warm weather, with almost constant mild R or showers. A splendid month for the farmers.

ROEBERRY.—From the 1st to the 5th, S storms, afterwards rough and squally weather generally. Winds mostly from S.W. to N.

IRELAND.

CORK.—Generally fine and often bright. T on 11th, with a slight fall of H.

DROMORE.—A very fine month, and vegetation made fair progress. Spring work well advanced.

WATERFORD.—R 1·59 in. below the average. S on 1st and 2nd; H on 30th and 31st. Mean temp. 42°·9.

ROSS, O'BRIENSBRIDGE.—A most favourable month for agricultural work. Some sharp frosts, but no excessive cold or violent wind; more than the average amount of sunshine, and no fog.

DUBLIN.—A moderately favourable month, with N.W. and W. winds. The beginning of the month was cold, but genial weather was experienced from time to time. Fogs on four days; high winds on nine days; gales on four days; S or sleet on two days; H on five days.

OMAGH EDENFEL.—The month had but few characteristics of March. Hardly any E. wind, and but the sign of S on one occasion. The absence of drying winds, with a R more persistent than heavy, occasioned a late seed time, but vegetation was otherwise in advance of the average.

PRACTICAL USE OF THE EARTH'S INTERNAL HEAT.

According to the *American Meteorological Journal* an attempt is about to be made at St. Augustine, Flo., to sink a 12-inch artesian well to a depth sufficient to obtain water hot enough to heat buildings, pure enough for domestic purposes, and with pressure enough to run heavy machinery. Water can be found in Florida by boring 250 feet; and it is known that the artesian wells in that State have considerable pressure, and from a depth of 600 feet send water of warm temperature to a height of 45 feet when piped. The earth's internal heat is already forced into practical service at Pesth, where the deepest artesian well in the world is being sunk to supply hot water for public baths and other purposes. This well supplies daily 176,000 gallons of water heated to 158 deg. Fahrenheit, and the boring is to be continued until the temperature of the water is raised to 176 deg. Heavy machinery is run by artesian well power in many parts of France, and the experience of the French shows that the deeper the well the greater the pressure and the higher the temperature. At Grenelle, a well sunk to the depth of 1802 feet, and flowing daily 500,000 gallons, has a pressure of 60 lbs. to the square inch, and the water from this well is so hot that it is used for heating the hospitals in the vicinity.—*Nature.*